National Aeronautics and Space Administration

Stratospheric and Mesospheric HO_2 observations from Aura MLS

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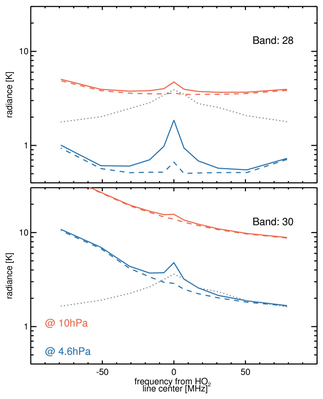
Introduction

- In the mesosphere O_3 chemistry is controlled by catalytic cycles involving the HO_x (OH, HO_2 and H) family.
- At these heights, despite the apparent simplicity of its chemistry, models have under-predicted the amounts of O_3 at such altitudes, an issue known as the "O_3 deficit problem".
- Furthermore, models were not able to give a complete picture of the HO_x chemistry in the middle atmosphere, in part due to the relatively lack of observations of HO_2 in the mesosphere.
- In this poster, we introduce an offline HO_2 retrieval for MLS. This new retrieval extends the HO_2 vertical range well into the mesosphere allowing us to fully study the HO_x family and its interactions with O_3.

MLS HO_2 Observations

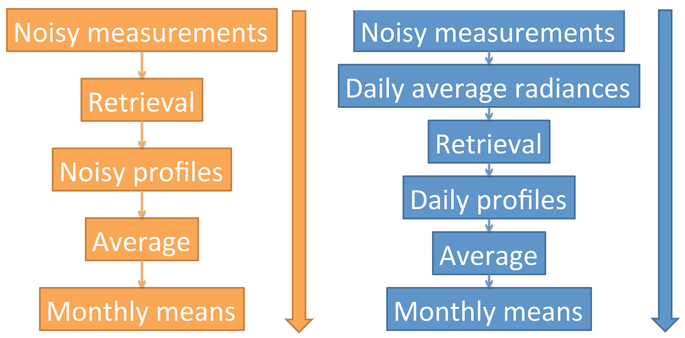
- MLS observes two sets of HO_2 emission lines. In both cases the ~1K HO_2 signal is relatively small compared to the 2 to 4K individual limb radiances precision.
- Some averaging is required to obtain HO_2 abundances with a useful signal to noise ratio.



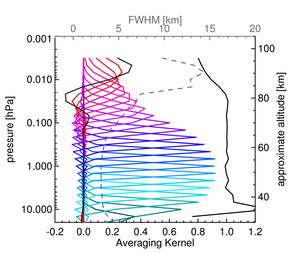
Average MLS radiance as detected by the bands 28 and 30 sorted into day (solid line) and night (dashed line) time measurements. Average is from 55S and 55N and for limb tangents from 10 to 4.6 hPa for January 2005. The dotted gray line is the expected single scan noise.

Retrieval Methodology

- To date, two different approaches to do the required averaging and inversion has been implemented.
- The standard production approach (MLS L2) and the offline (MLS OL2).



Vertical resolution

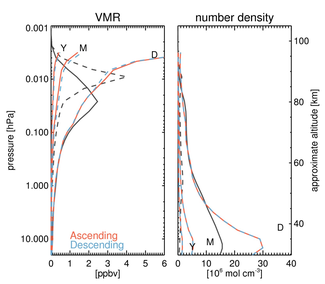


Averaging kernels for the retrieval of HO_2 mixing ratio at the equator (those at other latitudes are very similar).

The black line is the integrated area under each kernel: values near unity indicate that most information was provided by the measurements while lower values indicate that the retrieval was influenced by the *a priori*.

The dashed gray line is a measure of the vertical resolution of the retrieved profile (derived from the full width at half maximum (FWHM) of the averaging kernels approximately scaled into kilometers).

Precision



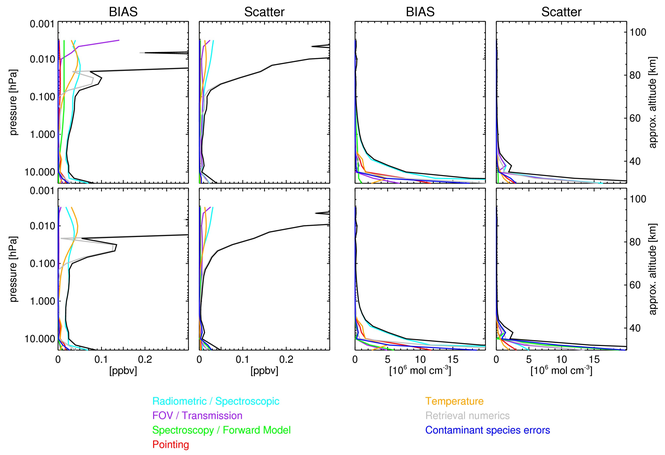
Expected precision for a daily (D), monthly (M) and yearly (Y) 10° latitude bin. The black lines show typical HO2 profiles, daytime in solid and nighttime dashed. This profile is a yearly average over all latitudes of the WACCM model

Systematic errors

Estimated impact of various families of systematic errors on the MLS offline HO_2 observations.

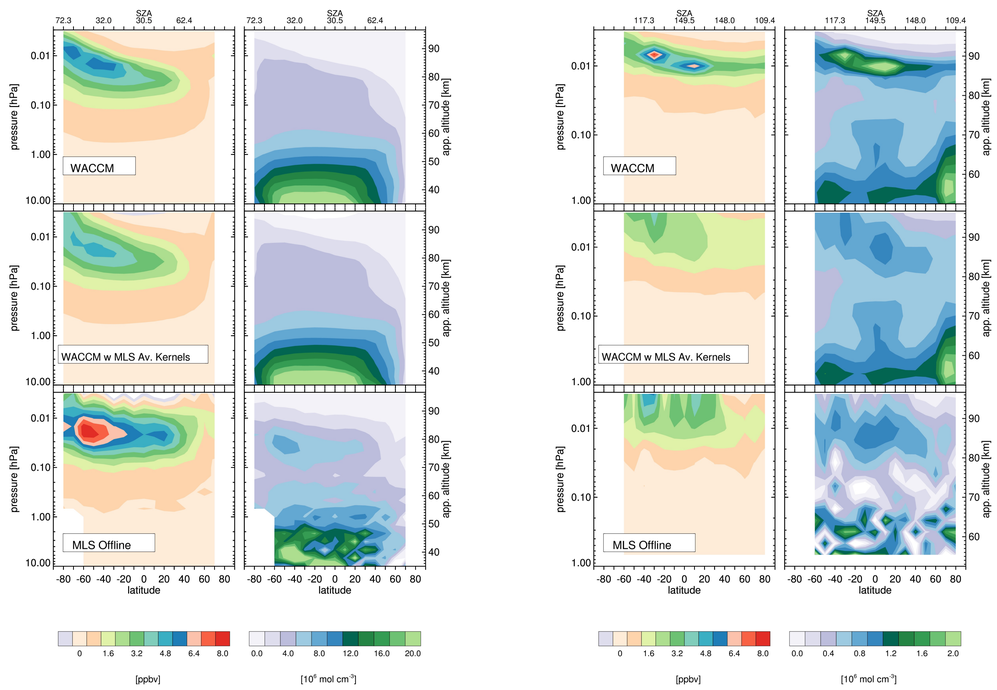
The top panel corresponds to the daytime data while the lower panel corresponds to nighttime.

The left panels show the biases and additional scatter introduced by each family of systematic errors in VMR while the right panel show them in number density.



Comparisons with WACCM

January 2005 monthly daytime (right) and nightime (left) zonal mean for the HO_2 MLS offline observations and the WACCM model. To alleviate biases in the MLS HO_2 daytime data, the daytime-nighttime differences are used as a measure of daytime HO_2 for pressures between 10 and 1 hPa. The MLS averaging kernels were applied to the WACCM dataset to fairly compare the two.



Conclusions

The results shown here suggest that this offline retrieval is a viable way to study mesospheric HO_2 interactions. This new dataset -in addition to the MLS OH, H_2O and O_3 measurements- enables more to study of the impact of the HO_x family upon mesospheric O_3.

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